Norio SAHASHI*: **Morphological and taxonomical studies on Ophioglossales in Japan and the adjacent regions** (7)** **Examination of *Sceptridium daucifolinm*** (2)

佐橋紀男*: 日本および近隣産ハナヤスリ目の形態学的分類学的研究（7）ホウライハナワラビ類の検討（2）

(Pl. XIII-XV)

Spore morphology Spores were mounted directly with glycerine jelly. Acetolysed spores often show a great amount of swelling (Erdtman et al., An introduction to a Scandinavian pollen flora p. 63. 1961), hence the author did not use the chemical treatment (acetolysis) for preparation of the spores. Spores are described following Sahashi (1976).

1a. Sceptridium daucifolium var. daucifolium (Pl. XIV. K-P).

Shape: Trilete. Amb subtriangle (ST) to rounded triangle (RT) or often triquete (TQ), proximal part (PP) flatly pyramidal to convex, distal part (DP) hemispherical or heavily arched. Size: 19(17-24) × 24(21-26) μm. Laesura: ca. E/2 the length of the spore, up to 2 μm tall at the proximal pole. Exine: Thin, semitransparent, ca 1.5 μm thick. Ornamentation by SEM: Irregular papillae are densely covering both on proximal and distal faces. At high magnification, these projections are sometimes uniting to form reticulum-like pattern on the distal face (Pl. II. N & P) and beset with minute granules. Papillae up to 2 μm tall, 0.5-1 μm in diameter at the base.

Spores from syntype (Pl. XIV. K & L) were fairly immatured grains, the surface is decorated with irregular murus-like ridges, papillae which appear on those ridges when matured are not yet deposited (Pl. XIV. L.).

1b. Sceptridium daucifolium var. intermedium (Fig. 7. C & D. Pl. XV. Q-T).

Shape: Trilete to rarely monolete. Amb ST to RT or often TQ, PP flatly pyramidal to convex, DP hemispherical to heavily arched. Size: 24(20-27) × 28(25-33) μm. Laesura: 8-16 μm long, slightly ridged up to 2 μm tall at the proximal pole. Exine: 1.5-2 μm thick, semitransparent. Ornamentation by SEM:

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** Continued from Journ. Jap. Bot. **56**: 339-347 (1981).

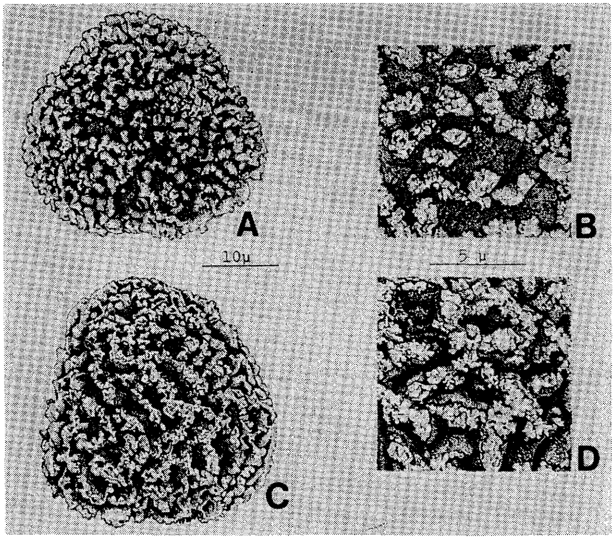

Fig. 7. Spore ornamentation of *Screptridium*. A, B. *S. javanicum*. A. Polar view, distal face, showing distinct dense papillae. B. A part of magnified distal face. C, D. *S. daucifolium* var. *intermedium*. C. Polar view, distal face, showing reticulum-like pattern. D. A part of magnified distal face.

distinct dense papillae are frequently uniting to form reticulum-like pattern or linear ridge with free end (Pl. XV R & T). The papillae up to 2.5 μm tall, 0.5-1 μm in diameter at the base. Interrupted lumina up to 5 μm in diameter.

1c. Sceptridium daucifolium var. kanaii (Pl. XIV I & J).

Shape: Trilete or often intermediate form to monolete. Amb RT to ST, PP flatly pyramidal to convex, DP hemispherical to heavily arched. Size: 30(28-33)×35(32-40) μm. Laesura: ca E/2 the length of the spore, up to 2 μm tall at the proximal pole. Exine: 1.5-2 μm thick, semitransparent. Ornamentation by SEM: Reticuulum-like pattern. Papillae (up to 2.5 μm tall, 0.5-1 μm in diam.) very frequently uniting to make irregular lumen, up to 5 μm in diameter, and beset with fine granules (Pl. XIV J).

2. Sceptridium formosanum (Pl. XV U-X).

Spores of this species were described in detail in the previous paper under *S. daucifolium*, using materials from Ryukyus (Sahashi 1976). In the present study, therefore, those of materials collected from type locality in Taiwan, and Isl. Okinoerabujima, southern part of Ryukyus were observed.

Shape: Trilete. Amb RT to ST to rarely TQ, PP flatly pyramidal to convex, DP hemispherical to heavily arched. Size: 19(17-22) × 22(19-25) μm. Laesura: ca E/2 the length of the spore, slightly ridged up to 2 μm tall at the proximal pole. Exine: Thin, semitransparent, ca 1.5 μm thick. Ornamentation by SEM: Distinct dense papillae (up to 2.5 μm tall, 0.5-1 μm in diam.) sometimes or often uniting to form interrupted reticulum or linear ridge withe free end (Pl. XV V & X), and beset with minute granules.

3. Sceptridium javanicum (Fig. 7. B & B. Pl. XIII A-H).

Shape: Trilete. Amb usually RT, sometimes ST, PP flatly pyramidal to convex, DP hemispherical to heavily arched. Size: 24(21-27) × 28(25-32) μm. Laesura: Long, ca E/2 the length of the spore, slightly ridged up to 2 μm tall at the proximal pole. Exine: 1.5-2 μm thick, semitransparent. Ornamentation by SEM: Distinct dense papillae usually not uniting, but sometimes these irregular papillae uniting to form linear ridge or interrupted lumen on the distal face (Pl. XIII B, D, F & H). The papillae up to 2 μm tall, 0.5-1 μm in diameter at the base, and beset with fine granules.

Cytological observations All the materials used in this study have been cultivated in the green house or a half shaded place in the garden at Funabashi, Chiba Prefecture. For the study of meiosis, young fertile fronds were fixed in Newcomer's fluid (Science 118: 161, 1953) and observed by squashed method. The author could not obtain any materials of living plant of *S. daucifolium* var. *daucifolium*, var. *intermedium* and var. *kanaii*. However, Manton & Sledge (1954) reported n = 90 from materials of *B. daucifolium* in Ceylon.

Sceptridium formosanum (Fig. 8. B).

Chromosome numbers in materials from Isls. Yakushima, Tokunoshima and Okinoerabujima were counted n = 90, and those from Taiwan were n = 90 or ca

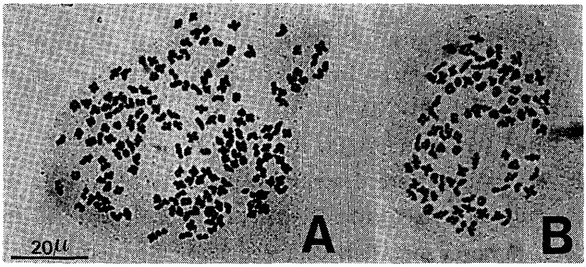

Fig. 8. Chromosomes of *Sceptridium*. A. *S. javanicum* from Isl. Bali, showing n = ca 180 chromosomes in meiosis. B. *S. formosanum* from Isl. Okinoerabujima, Ryukyus, showing n = 90 chromosomes in meiosis.

90. Nishida et al. (Journ. Jap. Bot. 39: 141, 1964) had already reported n=90, using materials from Isl. Yakushima under *S. daucifolium*.

Sceptridium javanicum (Fig. 8. A).

Chromosome numbers in meiosis in the present materials were counted n= ca 179-181. Some small univalent-like chromosomes were observed, therefore the author treats that the chromosome number of this species is n=ca 180. This is one of the largest polyploid series as already known in *B. lanuginosum* (Jermy & Walker, 1977).

The author is grateful to the late Emer. Prof. K. Hisauchi, Prof. M. Ikuse and Prof. T. Ohmoto of Toho University and Emer. Prof. H Ito, Tokyo Kyoiku University for their helpful advices. He is also indebted for permission to use valuable herbarium specimens to the following directors and curators: Drs. S. Serizawa (Aichi Kyoiku University; AICH), A.C. Jermy (BM), K. Kartawinata (BO), M. Nishida (Chiba University; CHIBA), F.M. Jarrett (K), S. Sako (KAG), K. Iwatsuki (KYO), C. Kalkman (L), S. Kobayashi (MAK), F. Badré (P), C.M. Kuo (TAI), J. Murata (TI), T. Nakaike (TNS), T. Hamaya (TOFO), T. Nakamura (Tokyo University of Agriculture; TUA), K. Sohma (TUSG) and A.R. Smith (UC). His sincere thanks are due to Miss S. Maeda of Toho University for drawing the figures used in the present paper.

References

Jermy, A.C. & T.G. Walker 1977. A note on the cytology of *Botrychium lanuginosum* and the occurrence of the genus in Malesia. Gard. Bull. **30**: 293-298. Manton, I. & W.A. Sledge 1954. Observations on the cytology and taxonomy of the pteridophyte flora of Ceylon. Phil. Trans. Roy. Soc. London **238B**: 127-185. Sahashi, N. 1976. Spore morphology of the Japanese species of the Botrychiaceae. Journ. Jap. Bot. **51**: 326-339. Tagawa, M. 1948. Fern miscellany (1). Journ. Jap. Bot. **22**: 160-165.

Explanation of plates XIII-XV

Pl. XIII. SEM photomicrographs of spores of *Sceptridium javanicum*. A-B. Material from Isl. Bali, type specimen. A. Polar view, proximal face, showing clearly Y-marked laesurae. B. A part of magnified distal face, showing dense papillae, not making reticulum. C-D. Material from Isl. Java, paratype specimen. C. Polar view, distal face, showing distinct dense papillae.

D. A part of magnified distal face. E–F. Material from Isl. Lombok. E. Polar view, distal face, showing some interrupted ridges making some reticulum-like pattern. F. A part of magnified E. G–H. Material from Sabah (KYO). G. Polar view, distal face, showing distinct dense papillae. H. A part of magnified G.

Pl. XIV. SEM photomicrographs of spores of *Sceptridium daucifolium*. I–J. *S. daucifolium* var. *kanaii*, type specimen. I. Polar view, distal face, showing reticulum-like pattern. J. A part of magnified I, showing interrupted ridges. K–P. *S. daucifolium* var. *daucifolium*. K–L. Syntype specimen of *Botrychium daucifolium* (BM). K. An immature grain, proximal face. showing slightly ridged Y-marked laesurae. L. A part of distal face, papillae are not yet deposited on the murus-like ridge. M–N. Material from E. Nepal (TI). M. Polar view, proximal face, showing clearly Y-marked laesurae. N. A part of enlarged distal face, showing papillae uniting to form irregular reticulum. O–P. Material from Sri Lanka (UC). O. Polar view, distal face, showing interrupted reticulum-like pattern. P. A part of O.

Pl. XV. SEM photomicrographs of spores of *Sceptridium daucifolium* var. *intermedium* and *S. formosanum*. Q–T. *S. daucifolium* var. *intermedium*, type specimen from E. Himalaya. Q–R. Material from Darjeeling (KYO). Q. Polar view, distal face, showing reticulum-like pattern. R. A part of Q, showing interrupted ridges beset with fine granules. S–T. Material from E. Nepal (TI). S. Polar view, distal face, showing reticulum-like pattern. T. A part of enlarged distal face, showing linear ridge with free end. U–X. *S. formosanum*. U–V. Type specimen (KYO). U. Polar view, proximal face, showing clearly Y-marked laesurae. V. A part of enlarged distal face, showing papillae uniting to make some irregular ridges. W–X. Materials from Ryukyus. W. Polar view, proximal face, showing clearly Y-marked laesurae, material from Isl. Tokunoshima (TOHO). X. A part of magnified distal face, showing uniting papillae to form irregular ridges, material from Isl. Okinoerabujima.

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東南アジア，マレーシアなどに広く分布し，これまでホウライハナワラビとされていたものは，自生地の調査，内外のハーバリウム標本の精査，多年にわたる栽培結果，並びに細胞学的および胞子の観察から次の3種2変種に分けるのが妥当と考えられる。す

なわち，

1. *Sceptridium daucifolium*

1a. Var. *daucifolium* シマオオハナワラビ（矢部），n=90，分布：おもにインド，ヒマラヤ，インドシナ半島。

1b. Var. *intermedium*（新変種）ナガホホウライハナワラビ，分布：ヒマラヤ東部。

1c. Var. *kanaii*（新変種）ヒマラヤハナワラビ，分布：，今のところ中央ネパール，カトマンズ近郊のみ。

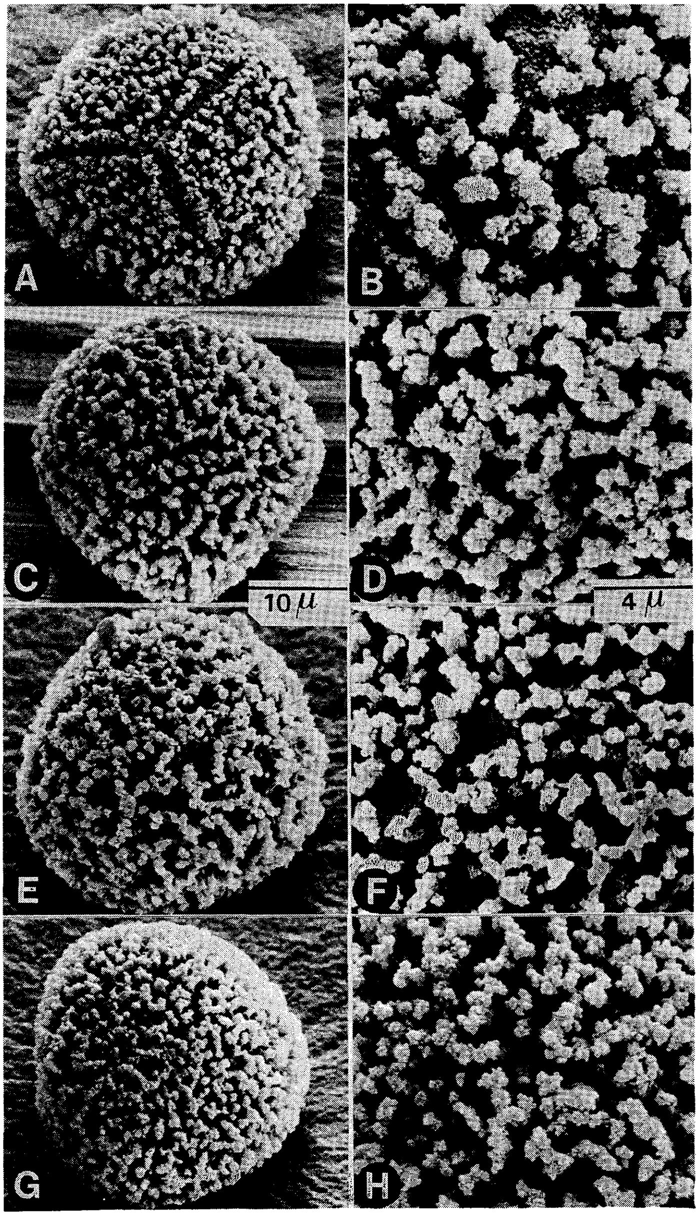
2. *S. formosanum* ホウライハナワラビ（田川），n=90，分布：台湾，中国南部，ヒマラヤ東部，琉球，九州（北限は鹿児島県田代町）。

3. *S. javanicum*（新種）ジャワハナワラビ，分布：インドネシナ，ボルネオ，フィリピン，ポリネシア（サモア，フィージー，タヒチ）。

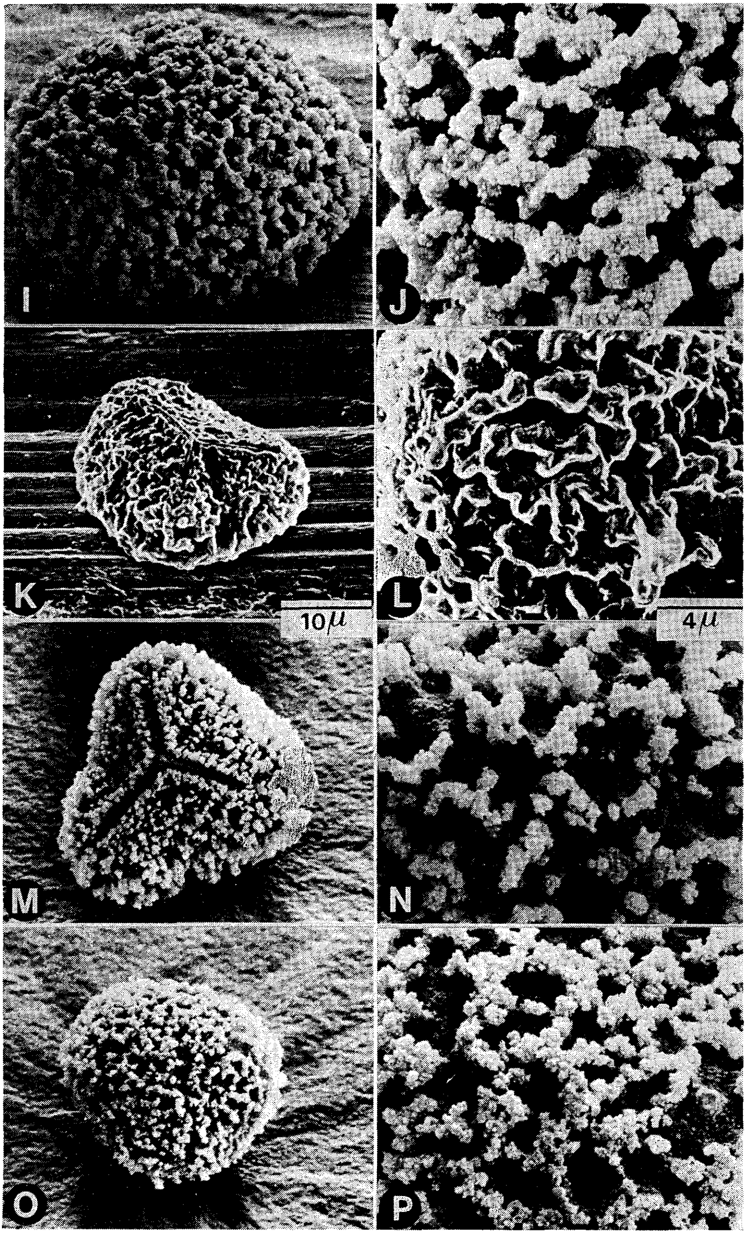
筆者の調査したかぎりでは上記の島々のみで，アジア大陸には存在しない。また南太平洋のものは大形で多少形態的には本種とは違うようにもみえるが，一応本種に含めておく。本種の最も特筆すべき点は n=ca 180 という高次倍数性の染色体数を持つ点である。これまでにハナワラビ科ではニューギニアのアリサンハナワラビで n=180 を Jermy ら（1977）が報告しているにすぎない。

検索表による区別点は次のとおりである。

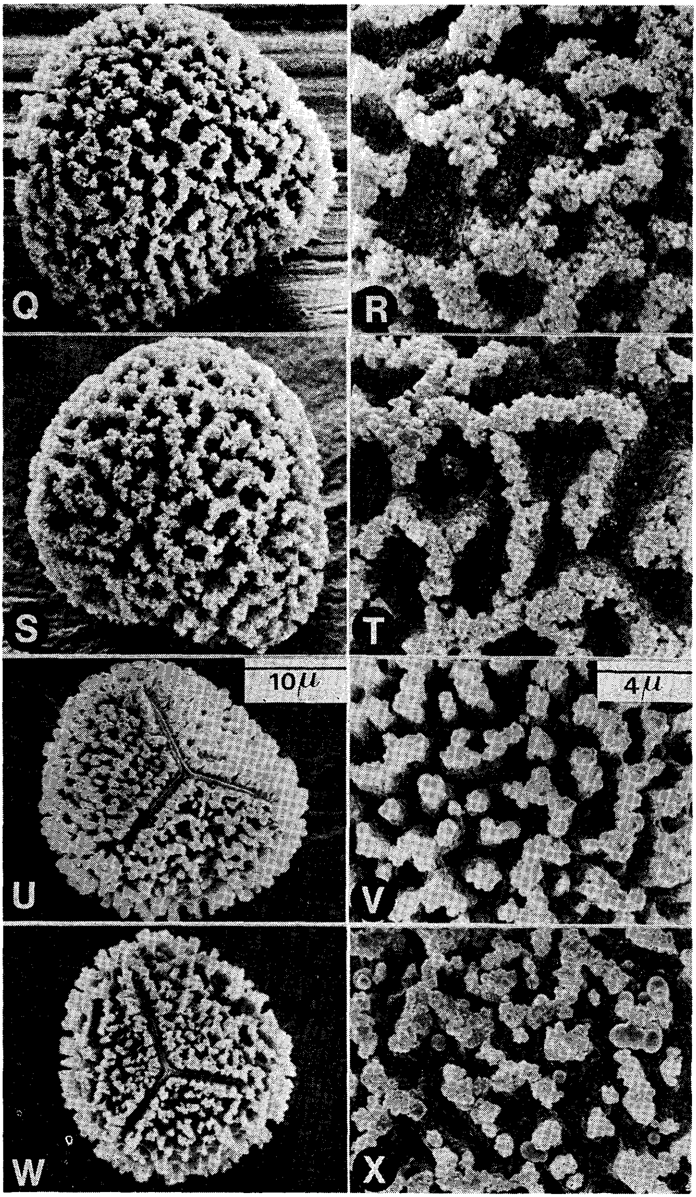
A．共通柄は長い，体長の½か，それ以上裸葉柄は短い。通常 4 cm 位。
  B．実葉片は裸葉片より抜きでる。胞子の赤道径 25～32 μ・・・・3．ジャワハナワラビ
  B．実葉片は裸葉片よりわずか，あるいはほとんど抜きでない。胞子の赤道径 21～26 μ・・・・1a，シマオオハナワラビ
A．共通柄は短い，体長の⅓か，それ以下。
  B．実葉片は裸葉片より抜きでる。
    C．胞子の赤道径 25～35 μ，小羽片の辺縁は通常鋸歯状・・・・1b，ナガホホウライハナワラビ
    C．胞子の赤道径 32～40 μ，小羽片の辺縁はほぼ平滑・・・・1c，ヒマラヤハナワラビ
  B．実葉辺は裸葉片よりわずか，あるいはほとんど抜きでない。胞子の赤道径 19～25 μ・・・・2．ホウライハナワラビ



N. SAHASHI: Ophioglossales in Japan



N. SAHASHI: Ophioglossales in Japan



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